TF 2169

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TF 2169

Pulse Modulator

INSTRUCTION MANUAL

MP MASTER
MA31180

mi
MARCONI INSTRUMENTS

Instruction Manual

No. EB 2169

for

Pulse Modulator

TF 2169

Code: 52169-900J

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MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

Contents

Chapter 1 GENERAL INFORMATION

1.1 Introduction ... 3
1.2 Data summary ... 3
1.3 Accessories ... 4

Chapter 2 OPERATION

2.1 Fitting TF 2169 to TF 2015 ... 5
2.2 Making connections ... 6
2.3 Setting output level ... 6

Chapter 3 TECHNICAL DESCRIPTION

3.1 Mechanical characteristics ... 7
3.2 Circuit summary ... 7

Chapter 4 MAINTENANCE

4.1 Introduction ... 9
4.2 Screw fasteners ... 9
4.3 Access to sub-assemblies ... 9
4.4 Test equipment ... 9
4.5 Performance checks ... 9
4.6 Insertion loss ... 9
4.7 CW suppression ... 10
4.8 Pulse output ... 11
4.9 Pulse rise time ... 11
4.10 Attenuator ... 11
4.11 Modulator diodes ... 11
4.12 Replacing transformers ... 11
4.13 Additional information ... 12

Chapter 5 - Not assigned

Chapter 6 REPLACEABLE PARTS

6.1 Introduction ... 13
6.2 Ordering ... 13
6.3 Component references ... 13

Chapter 7 CIRCUIT DIAGRAMS

Fig. 7.1 Pulse Modulator TF 2169 ... 17

Chapter 1

General information

1.1 INTRODUCTION

Pulse Modulator TF 2169 is designed to be used in conjunction with a signal generator to produce high quality pulsed r.f. signals. The modulator requires two inputs : the r.f. carrier from a signal generator and a pulse waveform from an external pulse generator. The pulsed r.f. output is taken via a built-in step attenuator.

The modulator is primarily designed for use with Signal Generator TF 2015 so it is dimensioned and constructed to be easily fitted to the underside of TF 2015 such that the combination appears as a single instrument. It can also be used with other signal generators similar to TF 2015 in frequency range, output impedance, output level etc.

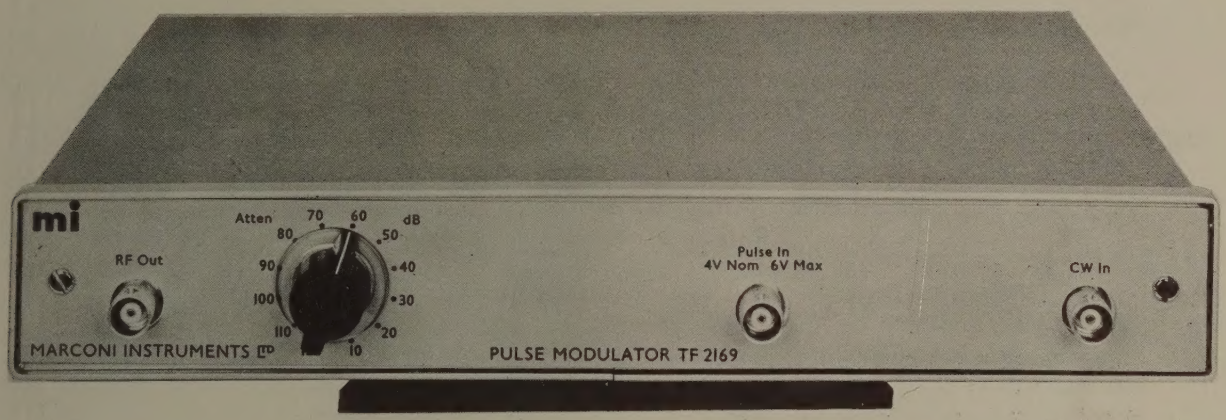


Fig. 1.1 Pulse Modulator TF 2169

1.2 DATA SUMMARY

Characteristic		Performance
CW INPUT		
Frequency range :		10 MHz to 520 MHz.
Level :		-7 dBm (100 mV) to -17 dBm (30 mV).
Impedance :	APPROX	50 Ω.
PULSE INPUT		
~~Minimum~~ REQUIRED level :		4 V into 50 Ω.
Maximum level :		6 V into 50 Ω.
Polarity :		Positive or negative-going.
Impedance :	APPROX	50 Ω.

RF OUTPUT

Carrier insertion loss :	8 to 12 dB.
Attenuator range :	0 to 110 dB in 11 steps Panel marked 10 to 120 dB to allow for modulator insertion loss of 10 dB.
Attenuator accuracy :	±0.3 dB per 10 dB step. ±1 dB cumulative.
Output impedance :	Approx 50 Ω.
Pulse durations :	100 ns to infinity (d.c. coupled).
Pulse rise times (levels 10 to 90%) :	Less than 25 ns.
Carrier suppression :	-70 dB from 10 to 80 MHz falling to -40 dB at 520 MHz.
Input pulse present at output :	Less than 10% of peak carrier amplitude

DIMENSIONS AND WEIGHT

Height	Width	Depth	Weight
52 mm (2.05 in)	274 mm (10.8 in)	268 mm (10.55 in)	1.7 kg (3.75 lb)

1.3 OPTIONAL ACCESSORIES

Interconnecting cable, (TF 2015 to TF 2169)	MI code 43129-106D.
Mounting kit (to be fitted to TF 2015)	MI code 46883-214N.
Mounting kit (to be fitted to TF 2169)	MI code 46883-220F.

Chapter 2

Operation

The operating instructions given in this chapter cover the use of TF 2169 with Signal Generator TF 2015.

2.1 FITTING TO SIGNAL GENERATOR TF 2015

Two mounting kits, MI code 46883-214N and 46883-220F, are available to enable TF 2169 to be fitted to TF 2015.

Mounting kit 46883-214N

This is fitted to Signal Generator TF 2015 as follows :

(1) Turn TF 2015 upside down and remove the bottom section of the case.

(2) Dismantle the tilt bar fitted at the front and discard the plate with the two holes and two slots.

(3) Replace the discarded plate with one of the latching plates supplied (joggled ends of plate inwards). Refit the tilt bar.

(4) Using the fixing supplied, fit the two plastic stands to clamp the latching plate.

(5) Remove the two rear stands and refit to clamp the second latching plate using existing fittings; then refit the bottom section of the case.

Mounting kit 46883-220F

This is fitted to Pulse Modulator TF 2169 as follows :

(1) Turn TF 2169 upside down and remove the bottom section of the case.

(2) Dismantle the tilt bar fitted at the front and discard the plate with the two holes and two slots.

Fig. 2.1 Signal Generator TF 2015 with Pulse Modulator TF 2169

(3) Replace the discarded plate with one of the two latching plates supplied (latches downwards). Refit the tilt bar.

(4) Remove the two rear stands and refit to clamp the second latching plate, then refit the bottom section of the case.

(5) Position TF 2015 on top of the modulator and clamp the two instruments together using the clips now attached to each side of the modulator case.

2.2 MAKING CONNECTIONS

All three coaxial connectors on the modulator are type BNC 50 Ω and are connected as follows :

(1) CW IN

Use cable 43129-106D, available as an optional accessory, to connect to RF OUTPUT on TF 2015. Ensure that the connectors are securely mated to minimize r.f. leakage.

When the modulator is used with other signal generators the interconnecting cable used must be kept as short as possible.

(2) PULSE IN

Connect to the output of the pulse generator by means of a 50 Ω coaxial cable.

(3) RF OUT

Connect to the equipment under test by means of a 50 Ω coaxial cable.

2.3 SETTING OUTPUT LEVEL

The output level is set by adjusting the TF 2169 attenuator and the FINE RF OUTPUT control on TF 2015, with the stepped r.f. output control (coarse attenuator) on TF 2015 at 0. The accuracy of the output amplitude can be accepted (in the worst case) as being the sum of the TF 2015 level error and the insertion loss of TF 2169 i.e. ±3 dB up to 100 MHz or ±4 dB from 100 MHz to 520 MHz.

Chapter 3

Technical description

The information given in this chapter should be read with reference to the circuit diagram Fig. 7.1.

3.1 MECHANICAL CHARACTERISTICS

The modulator is designed to be easily fitted to Signal Generator TF 2015 and to provide easy access to all components for repair or replacement.

Printed circuit boards and the attenuator are allocated unit identification numbers in the sequence A1, A2 and A3 and where practical the assembly is marked with this number. Silk screening is used to identify the components on the printed circuit boards.

Construction consists of front and rear panels supported by side members. The modulator box contains units A1 and A2 together with the filter circuits and the matching pads. The attenuator unit A3 is fitted to the front panel and inter-connection between units is made using semi-rigid coaxial cable.

The instrument case, which is in two sections and easily removed by extracting four screws, is fitted with a fold-away tilt bar.

3.2 CIRCUIT SUMMARY

TF 2169 consists of three basic sections :

Modulator A1
Modulator A2
Attenuator A3

The c.w. signal from TF 2015 is first applied to the input of the modulator A1. Output from A1 is passed to the second modulator A2 which applies the signal to the attenuator A3. Two series connected modulators are employed to give a good carrier suppression ratio in the absence of a pulse.

The modulating pulses are applied to A1 and A2 through low-pass filters and matching pads and the pulsed r.f. is passed to the attenuator unit through a frequency sensitive pad which holds the insertion loss of the modulator acceptably constant.

Attenuator unit A3 provides a loss of 110 dB in steps of 10 dB, but since the insertion loss of the modulators closely approximates 10 dB the attenuator outputs are shown on the panel as 10 to 120 dB. The pad sections consist of resistive networks with a characteristic impedance of 50 Ω. The unit is divided into compartments to ensure maximum shielding between pads. Pads are connected into circuit by micro-switches housed in screened compartments and operated in pairs by leaf springs actuated by cams on the central spindle.

Chapter 4

Maintenance

4.1 INTRODUCTION

This chapter contains information to enable the performance of the modulator to be maintained. It should be read with reference to Chapter 3 and the circuit diagram, Fig. 7.1.

4.2 SCREW FASTENERS

The screw threads used in the instrument are metric of various sizes. Ensure that screws removed are refitted in original positions.

4.3 ACCESS TO SUB-ASSEMBLIES AND COMPONENTS

Removal of case

The case is in two sections. Remove the four screws (two each side) at the rear of the case then slide off top and bottom sections.

Sub-assemblies A1 and A2

A1 and A2 are modulator assemblies which are contained within the modulator box. To obtain access remove the cover of the box, which is held by two retaining screws.

Filter circuits and matching pads

These are also contained within the modulator box in separately screened compartments.

Attenuator A3

This is directly accessible. The attenuator pads can be examined by removing the two screws holding the screening lid. Ensure that the r.f. gasket is correctly positioned before re-fitting the lid.

4.4 TEST EQUIPMENT

The test equipment required for maintenance and repair of the modulator is listed in Table 4.1.

4.5 PERFORMANCE CHECKS

The performance checks given in this section are simplified and of restricted range compared with those which would be needed to demonstrate complete compliance with the specification. They should be regarded only as providing a check procedure for use during routine maintenance to determine whether adjustment or repair is necessary. Any figures given are for guidance only and should not be taken as guaranteed performance figures unless they are quoted in the Data Summary, Sect. 1.2.

4.6 INSERTION LOSS

Test equipment : items a, d, f, g, h.

To check the insertion loss of TF 2169, proceed as follows :

(1) Connect the 4.5 V battery to PULSE IN on TF 2169.

(2) Connect the RF OUTPUT on TF 2015 to CW IN on TF 2169.

(3) Using the millivoltmeter (100 mV range) and the T connector loaded with 50 Ω, set TF 2015 for a c.w. output of 100 mV at 10 MHz.

(4) Set the attenuator on TF 2169 fully clockwise. Transfer the T connector loaded with 50 Ω to RF OUT on TF 2169. The indicated r.f. output from TF 2169 should be between 25 and 40 mV (100 mV - 10 dB ±2 dB).

(5) Reverse the battery polarity and check that the indicated output from TF 2169 is as given in (4).

(6) Repeat the test at various frequencies between 10 MHz and 520 MHz. If necessary change the value of C4 and/or R8 to obtain the required result.

Table 4.1

Item	Description	Recommended model
a	RF millivoltmeter	MI TF 2603.
b	Oscilloscope	Minimum requirements : (i) Time base : 50 ns/cm (ii) Rise time : 2 ns (iii) Amplitude measurement 0 to 10 V.
c	Multimeter	GEC Selectest.
d	4.5 V battery	Ever-ready 126 or equivalent.
e	Pulse generator	Minimum requirements : (i) PRF range : up to 1 MHz (ii) Pulse amplitude : up to 6 V (iii) Pulse width : variable from 100 ns (iv) Rise time : 10 ns (v) Output impedance : 50 Ω.
f	Signal generator	MI TF 2015.
g	Connecting cable TF 2015 to TF 2169	MI code 43129-106D.
h	T connector	MI TM 7948.
i	Spectrum analyser	Frequency range : 10 to 520 MHz.

4.7 CW SUPPRESSION

Test equipment : items d, f, i.

To check for c.w. suppression proceed as follows :

(1) Using cable 43129-106D (optional accessory) connect the RF OUTPUT on TF 2015 to CW IN on TF 2169, see Fig. 2.1.

(2) Using a short length of 50 Ω coaxial cable connect RF OUT on TF 2169 to the input of the spectrum analyser and connect the 4.5 V battery to PULSE IN on TF 2169.

(3) Set the attenuator on TF 2169 and the RF OUTPUT controls on TF 2015 fully clockwise.

(4) Set TF 2015 for a c.w. output at 10 MHz and the analyser with a reduced bandwidth to cover this frequency.

(5) Note the 10 MHz level shown on the analyser as a reference.

(6) Disconnect the battery and check that the level shown on the analyser is now greater than 70 dB below the level noted in (5).

(7) By setting the RANGE switch and the TUNE switch on TF 2015 to scan a frequency range from 10 to 80 MHz and by appropriately adjusting the analyser, check that over this frequency range the levels shown on the analyser are greater than 70 dB below the level noted in (5).

(8) Set TF 2015 and the analyser at 520 MHz and check that the level shown on the analyser is greater than 40 dB below the level noted in (5).

NOTE. To ensure that the noise level is minimized when making the checks adjust the analyser for a limited bandwidth.

4.8 PULSE OUTPUT

Test equipment : items b, e, f, g, h.

(1) Connect the output on TF 2015 to CW IN on TF 2169. Using 50 Ω coaxial cable connect the output of the pulse generator to PULSE IN on TF 2169. Connect a 50 Ω coaxial cable (as short as practical) between RF OUT on TF 2169 and the input of the oscilloscope terminated with 50 Ω.

(2) Set TF 2015 for an output of 100 mV (r.f. output controls fully clockwise). Set the pulse generator for an output of 4 V at a p.r.f. of 100 kHz, and for an approximate mark/space ratio of 1 : 1. Set the attenuator on TF 2169 fully clockwise.

(3) Measure and note the peak-to-peak c.w. output from TF 2169 and call this A.

(4) Set the CARRIER switch on TF 2015 at OFF. Then measure and note the peak-to-peak output from TF 2169 and call this B.

$\frac{B}{A}$ x 100 should not be greater than 10.

(5) Repeat the test at various frequencies to the measurement limit of the oscilloscope used.

4.9 RISE TIME

Test equipment : items b, c, f, g.

With the equipment as in 4.8 (1) and (2) but with the pulse generator output at a p.r.f. of 1 MHz and pulse width at 0.5 μs, check that the pulse rise times are less than 25 ns (measured between the 10% and 90% levels).

4.10 ATTENUATOR

Test equipment : item c.

It is only necessary to prove correct operation of the micro-switches and this can be satisfied by making a series of resistance measurements as follows :

(1) With the TF 2169 inputs disconnected, connect the multimeter set at low ohms range, to the RF OUT socket on TF 2169.

(2) Set the attenuator at 10 dB and check that the multimeter indicates a resistance of 35 - 55 Ω ±2%.

(3) Repeat the test for each additional switch position, checking that the measured resistance at each setting is 50 Ω ±2%.

If the attenuator unit is proved faulty it is recommended that it be returned to Marconi Instruments Ltd., for repair.

The complete unit can be lifted free of the instrument as follows :

(1) Remove the control knob and the nut holding the unit to the front panel.

(2) Remove the four screws holding the RF OUTPUT connector to the front panel.

(3) Remove the two screws holding the unit to the rear brass bracket and the attenuator connector terminating the semi-rigid coaxial cable.

(4) Lift the unit free of the instrument.

4.11 MODULATOR DIODES

These are specially selected to form a matched quad set. If a diode is proved to be faulty it will be necessary, if the performance of the instrument is not to be impaired, to replace the matched set.

4.12 REPLACING TRANSFORMERS

If modulator transformer, T1, T2, T3 and T4 are required to be replaced it is important that the replacement be connected in the same way as the removed component. The required connections for modulators A1 and A2 are shown in Fig. 4.1.

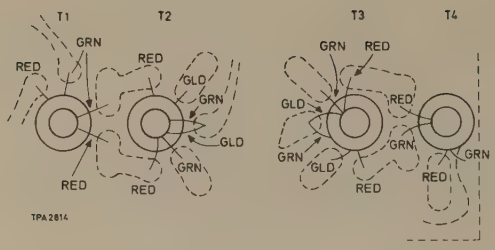


Fig. 4.1 Transformer connections

4.13 ADDITIONAL INFORMATION

If further information is required please write to or telephone Marconi Instruments Limited, Service Division - see address on back cover - or contact nearest representative, quoting the type and serial number on the data plate on rear of instrument.

If the instrument is being returned for repair please indicate clearly the nature of the fault or the work you require to be done.

Chapter 6

Replaceable parts

6.1 INTRODUCTION

Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification in the sequence A1, A2 and A3.

The complete component reference carries its unit number as a prefix e.g. A1C1 but for convenience in the text and on circuit diagrams the prefix is not used.

However, when ordering replacements or in correspondence the complete component reference must be quoted.

One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by † have their value selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

6.2 ORDERING

When ordering replacements, address the order to our Service Division (address on rear cover) or nearest agent and specify the following for each component required.

(1) Type* and serial number of instrument

(2) Complete circuit reference

(3) Description

(4) MI code

* as given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

6.3 COMPONENT REFERENCES

The components are listed in alpha-numerical order and the following abbreviations are used :

C	:	capacitor
Cer	:	ceramic
D	:	semiconductor diode
L	:	inductor
Met	:	metal
Ox	:	oxide
PL	:	plug
R	:	resistor
S	:	switch
SK	:	socket
T	:	transformer
†	:	value selected during test; nominal value listed
Ø	:	feed-through component
W	:	watts at 70 °C

Circuit reference	Description	M.I. code
Unit A0		
	When ordering prefix circuit reference with A0.	
	Low-pass filter	
C1	Cer Ø 50pF 10% 300V	26333-229U
C2	Cer Ø 50pF 10% 300V	26333-229U
C3	Cer Ø 50pF 10% 300V	26333-229U
C4	Cer Ø 50pF 10% 300V	26333-229U
C5	Cer Ø 50pF 10% 300V	26333-229U
C6	Cer 330pF 20% 500V	26383-136T
C7	Cer 330pF 20% 500V	26383-136T
L1	1μH	23642-549L
L2	1μH	23642-549L
L3	1μH	23642-549L
L4	1μH	23642-549L
R1	Met film 51Ω 2% ¼W	24773-242Z
SKA	BNC 50Ω socket	23443-443K
SKB	BNC 50Ω socket	23443-443K
SKC	BNC 50Ω socket	23443-443K
Unit A1		
	When ordering prefix circuit reference with A1.	
	Complete board	44827-288Y
C1	Cer 4.7pF 20% 500V	26343-113X
C2	Cer 0.001μF -20+80% 500V	26383-242P
C3	Cer 47pF 20% 500V	26343-113X
D1, D2, D3, D4	Selected diodes matched quad set	44529-004X
R1	Met film 36Ω 2% ¼W	24773-238A
R2	Met film 16Ω 2% ¼W	24773-230T
R3	Met film 33Ω 2% ¼W	24773-237K
R4	Met film 150Ω 2% ¼W	24773-253F
R5	Met film 150Ω 2% ¼W	24773-253F
T1	Transformer	43590-007J
T2	Transformer	43590-006L
T3	Transformer	43590-006L
T4	Transformer	43590-007J
Unit A2		
	When ordering prefix circuit reference with A2.	
	Complete board	44827-289N
C1	Cer 4.7pF 20% 500V	26343-113X
C2	Cer 0.001μF -20+80% 500V	26383-242P
C3	Cer 4.7pF 20% 500V	26343-113X
C4 †	Cer 10pF 20% 500V	26343-120B
D1, D2, D3, D4	Selected diodes matched quad set	44529-004X
L1	RF choke 0.22μH	23642-482L
R1	Met film 330Ω 2% ¼W	24773-261D
R2	Met film 150Ω 2% ¼W	24773-253F
R3	Met film 36Ω 2% ¼W	24773-238A
R4	Met film 16Ω 2% ¼W	24773-230T
R5	Met film 33Ω 2% ¼W	24773-237K
R6	Met film 150Ω 2% ¼W	24773-253F
R7	Met film 150Ω 2% ¼W	24773-253F
R8 †	Met film 68Ω 2% ¼W	24773-245U

For symbols and abbreviations see introduction to this chapter

Circuit reference	Description	M.I. code
T1	Transformer	43590-007J
T2	Transformer	43590-006L
T3	Transformer	43590-006L
T4	Transformer	43590-007J

Unit A3

When ordering prefix circuit reference with A3.

	Complete unit	44429-010W
Cam	(Pad 1) 30dB	31359-001K
Cam	(Pad 2) 30dB	31359-006U
Cam	(Pad 3) 20dB	31359-003Z
Cam	(Pad 4) 20dB	31359-002A
Cam	(Pad 5) 10dB	31359-004H
R1	Met film 790Ω 1% 3/8W	24764-401A
R2	Met film 790Ω 1% 3/8W	24764-401A
R3	Met film 247Ω 1% 3/8W	24764-405U
R4	Met film 247Ω 1% 3/8W	24764-405U
R5	Met film 71.2Ω 1% 3/8W	24764-403H
R6	Met film 53.3Ω 1% 3/8W	24764-401A
R7	Met film 53.3Ω 1% 3/8W	24764-401A
R8	Met film 53.3Ω 1% 3/8W	24764-401A
R9	Met film 53.3Ω 1% 3/8W	24764-401A
R10	Met film 61.1Ω 1% 3/8W	24764-402Z
R11	Met film 61.1Ω 1% 3/8W	24764-402Z
R12	Met film 61.1Ω 1% 3/8W	24764-402Z
R13	Met film 61.1Ω 1% 3/8W	24764-402Z
R14	Met film 96.3Ω 1% 3/8W	24764-404E
R15	Met film 96.3Ω 1% 3/8W	24764-404E
SA to SK	Microswitch UHF	23483-131A

Miscellaneous items

Coaxial cable (internal) SKB to modulator A1	43129-074X
Coaxial cable (internal) SKC (modulator A2) to A3	43129-073P
Control knob (attenuator 1 inch bar type)	41145-407B
Knob surround	41590-014F

For symbols and abbreviations see introduction to this chapter

Chapter 7

Circuit diagrams

Circuit notes

1. COMPONENT VALUES

Resistors : No suffix = ohms, k = kilohms, M = megohms.
Capacitors : No suffix = microfarads, p = picofarads.
Inductors : No suffix = henrys, m = millihenrys, μ = microhenrys.
† value selected during test, nominal value shown.

2. COMPONENT NOTES

Note 1. Cable shown 'a' is MI code 15650-904H.

Note 2. Diodes D1 to D4 are matched quad set MI code 44529-004X.

3. SYMBOLS

Symbols are based on the provisions of B.S.3939.

tag on printed board.

unit identification number.

4. CIRCUIT REFERENCES

These are, in general, given in abbreviated form.
See also introduction to Chap. 6.

Circuit modification - Fig. 7.1

R1, 51 Ω is removed. R1 is changed to 22 Ω and is now positioned outside the r.f. box and connected in series with SKA and C1 (pulse input).

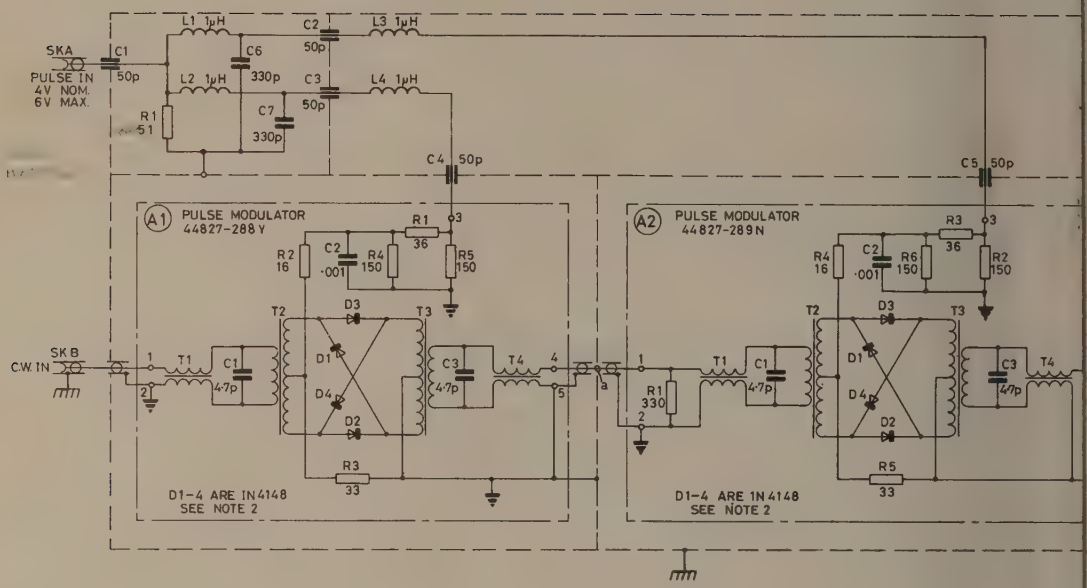
A1 and A2. .Note 2 changed to 'D1 - 4 are HP 5082-2835'.

C4 changed to 15 pF.

R8 changed to 56 Ω.

Replaceable parts

Unit A0		
R1	Met film 22 Ω 2% ½W	MI code 24573-033J
Unit A2		
C4	Cer 15 pF 10% 500V	MI code 26343-127Y
R8	Met film 56Ω 2% ½W	MI code 24773-243H


SKA
PULSE IN
4V NOM.
6V MAX.
C1
50p
L1 1μH
L2 1μH
C6
330p
C7
330p
R1
51
C2
50p
L3 1μH
C3
50p
L4 1μH
C4 50p
C5 50p
A1 PULSE MODULATOR
44827-288Y
R1
36
R2
16
C2
·001
R4
150
R5
150
T2
T3
D3
D1
D4
D2
R3
33
T1
C1
47p
C3
47p
T4
SK B
C.W. IN
D1-4 ARE IN4148
SEE NOTE 2
A2 PULSE MODULATOR
44827-289N
R3
36
R4
16
C2
·001
R6
150
R2
150
R1
330
R5
33
D1-4 ARE 1N4148
SEE NOTE 2

dB ATTENUATION			10	20	30	40	50	60	70	80	90	100	110	120
PADS IN CIRCUIT	1	30dB				X	X	X	X	X	X	X	X	X
	2	30dB										X	X	X
	3	20dB								X	X	X	X	X
	4	20dB			X			X	X	X	X		X	X
	5	10dB		X			X		X		X	X		X

dB ATTENUATION INCLUDES INSERTION LOSS OF 10 dB

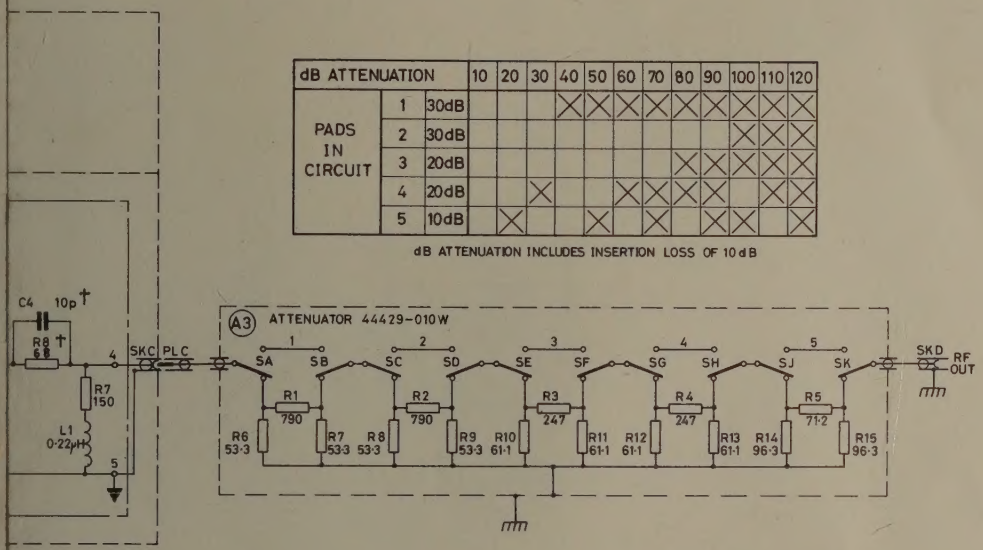


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Fig. 7.1 Pulse Modulator TF 2169

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